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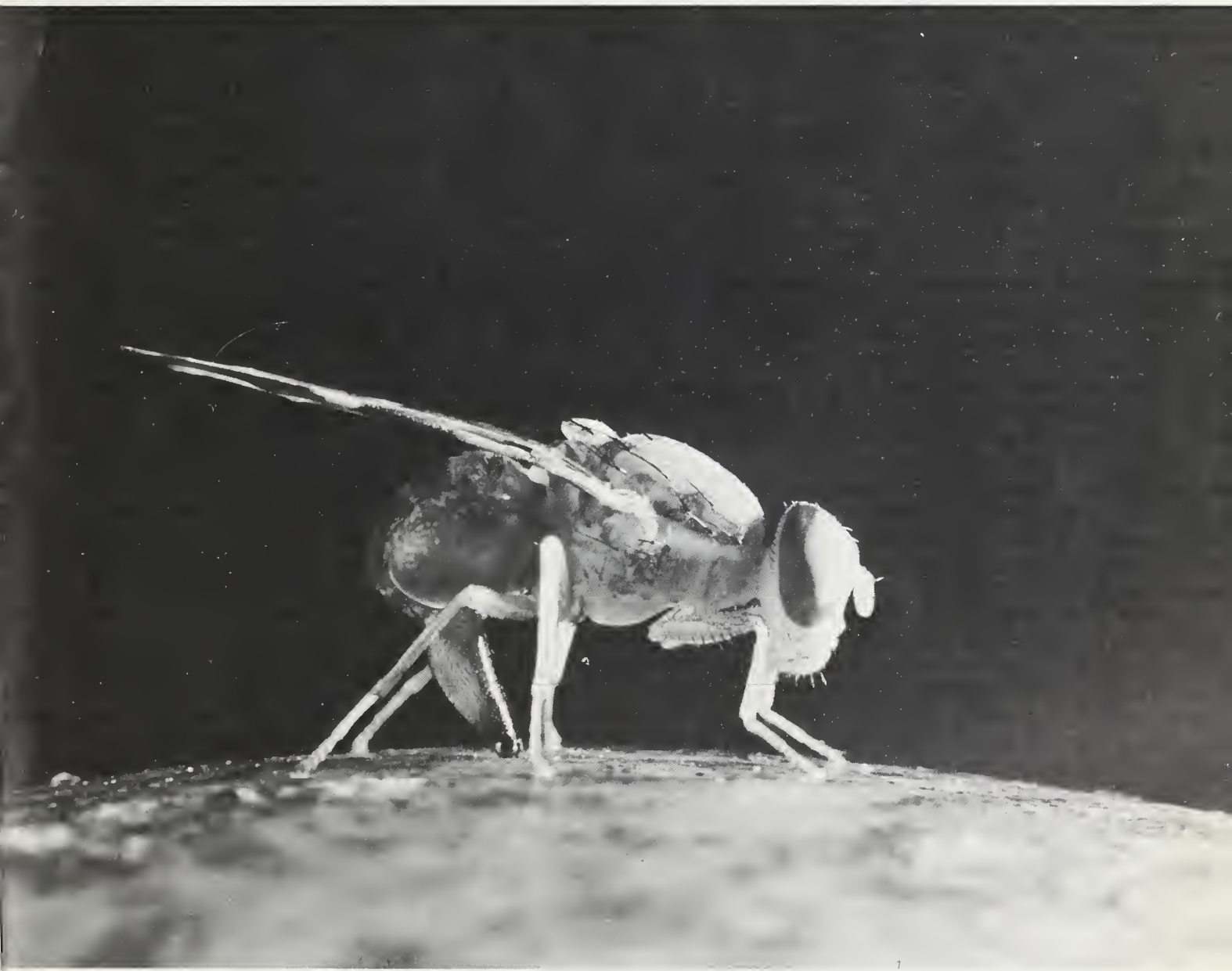
U.S. DEPARTMENT OF AGRICULTURE OCTOBER 1978



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An Endangered Species?

ONCE the mainstay of American economic, social and family life, the small farmer today occupies a space on a precipice. He stands between a proud heritage and his own uncertain future—an oracle demanding big farms, big machinery, and big production to feed an insatiable country and world.

The number of American farms had remained approximately stable between 1900 and 1940—about 6.4 million. Since 1940, that number has dwindled to 2.7 million. Within the agricultural sector, large operations have come to assume consistently greater importance. In 1950, 103,000 of the largest farms produced 26 percent of this country's agricultural production. Today, the largest 155,000 operations produce nearly 60 percent of our total agricultural sales.

About two-thirds of the farmers in America are classified as small; that is, they sell less than $20,000 worth of agricultural products per year. Collectively, these farmers control 31 percent of all farm assets, and they use those assets to produce about 11 percent of the nation's farm output.

The needs of the small farmer are different from those of the larger producers; to recognize and then to serve those needs requires a sensitivity to the differences in methods of management, availability of resources and other parameters within which the small farmer must operate. This magazine has reported, within the last year, research which can specifically help the small farmer. For example: a low-cost pecan harvester for small orchards; a new variety of blueberry specifically suited to small acreages and pick-your-own operations; a new, disease-resistant tomato; and a new, dwarf apple tree which requires less pesticides than a normal size tree. These developments are all especially applicable to the small operator. Pilot extension programs (in which paraprofessionals work with small farmers) in several states are reaching these people with research information on production, management and marketing.

But far more significant than these fruits of SEA's research and extension activity is the renewed commitment this Department has made to the small farmer. Over the last three months, USDA officials have been meeting with small farmers from every state in an effort to develop proposals for programs to aid the small operator.

Is the American small farmer an endangered species? Hardly. At a time when no one is entirely independent, he is the most nearly autonomous representative of American agriculture. Perhaps the self-sufficiency of the original farmers who comprised much of this country two centuries ago exists in some farmers today. And, given the vicissitudes inherent in a changing society, that same desire for self-determination is a part of the most nearly independent of these, America's small farmer.—*R.W.D.*

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COVER: A Carribean fruit fly lays her eggs on a grapefruit peel. SEA researchers in Gainesville, Fla. hope to develop strains of grapefruit which, like oranges, are naturally resistant to this costly citrus pest (0478X440–15A). Story begins on page 3.

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Bob S. Bergland, Secretary
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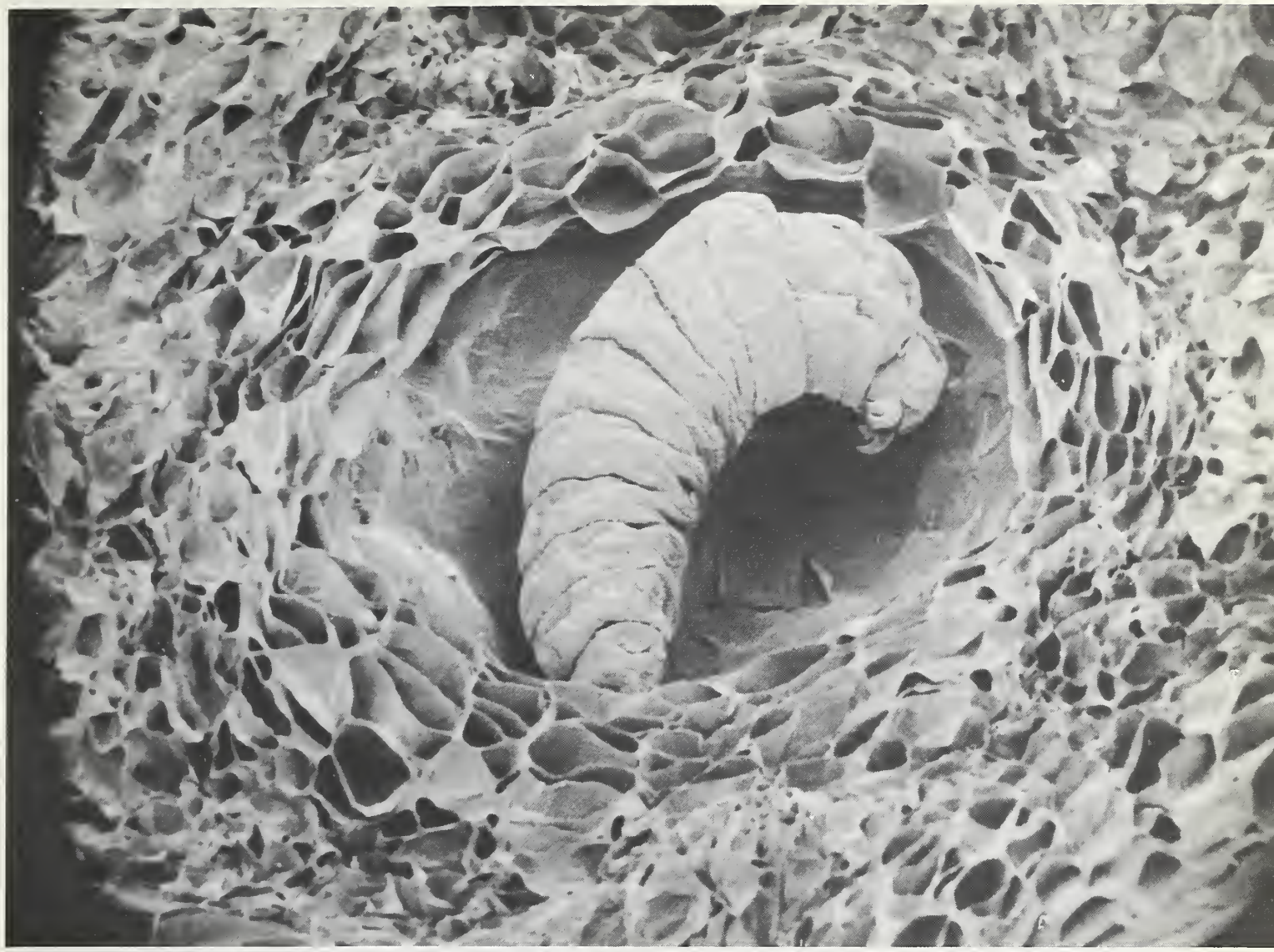
Anson R. Bertrand, Director of Science and Education



Citrus Chemicals Knock Out Fruit Fly

Above This scanning electron micrograph, taken by Ms. T. C. Carlysle, shows a dead Caribbean fruit fly larvae inside an oil gland of an orange peel (PN–4169).

NATURAL oils found in the peel of citrus, including oranges, grapefruit, and lemons, have been shown to be highly toxic to the eggs and larvae of the Caribbean fruit fly.

This finding ultimately could have two highly desirable results: it may reduce pesticide use and also costly handling procedures.

The discovery resulted from studies conducted to explain differences in resistance to this pest by oranges and grapefruit. Although oranges are occasionally attacked successfully by the Caribbean fruit fly, grapefruit (especially white varieties) are somewhat more vulnerable, depending upon their ripeness. Fully ripened grapefruit are appreciably more susceptible than immature fruit.

Luis Vinas, a graduate student in the Department of Entomology and Nematology, University of Florida, working under the direction of SEA entomologist Patrick Greany, found that while the flies laid their eggs readily into all these fruit, most progeny died. Further testing showed that

the peel oils were toxic to both the eggs and the larva.

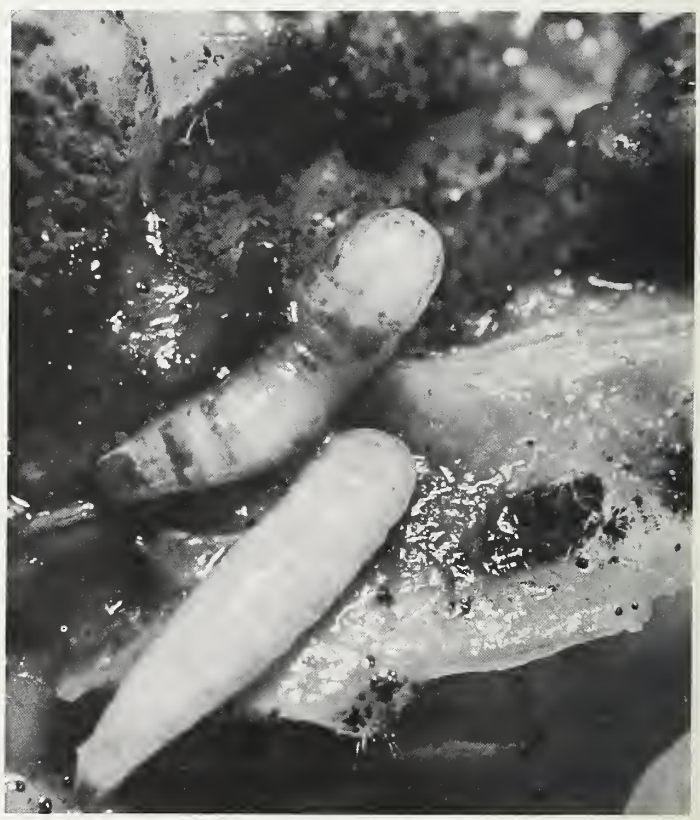
Subsequent studies have shown that a number of peel oil constituents are toxic and efforts are being made to determine which of these contribute most to resistance. Because the peel oils vary in composition among cultivars and according to fruit maturity, it may be possible to relate differences in susceptibility to specific chemical differences in the oils. In addition, analyses are being made to determine whether differences in peel oil content and peel morphology influence the resistance exhibited by various citrus cultivars.

Followup studies are planned to determine whether this information can be used to develop strains of grapefruit which are as resistant to Caribbean fruit fly attack as are oranges and lemons.

Additional studies will be performed with international cooperators to determine the effect of citrus chemicals on other, even more damaging species of fruit flies such as the Mediterranean fruit fly. The medfly has caused great damage to Florida citrus in the past and was eradicated only at great cost. According to SEA scientists, it might some day be possible to avoid or reduce insecticidal control of these species wherever they occur if resistant strains of citrus could be made available to growers.

Studies are being made in cooperation with chemist Paul L. Davis at the U.S. Horticultural Field Station in Orlando and chemists at the Citrus and Subtropical Products Laboratory in Winter Haven, Fla., to determine whether chemical tests could be used to indicate increased susceptibility and thereby indicate an optimal harvest date. The scientists hope that their findings may lead to reduced costs and reduced environmental impact from insecticides currently used against various fruit flies throughout the world.

Dr. Patrick Greany's address is: Insect Attractants, Behavior and Basic Biology Research Laboratory, P.O. Box 14565, Gainsville, FL 32604.—*P.L.G.*



Above right: *Dr. Greany probes damaged grapefruit whose susceptibility to fruit flies increases with ripeness (0478X439–16).*

Right: *Inside a ripe grapefruit, Caribbean fruit fly larvae thrive. Studies have shown grapefruit to be less resistant to damage from these fruit flies than are oranges and certain other citrus fruit (0378X275–17).*

Causes Sought for Delayed Puberty in Pigs

THE lard-type pig of 20 years ago lived in its natural habitat, outdoors. But today's pig is a lean-meat type, the result of genetic selection, and may spend its life in total confinement.

Changes in both the pig and its environment seem to have altered the reproductive behavior of gilts. What is commonly called delayed puberty is observed more frequently as confinement management becomes more common. Twenty to 30 percent of U.S. pigs are grown in total confinement, and the proportion is expected to increase.

Two reproductive problems are seen in confinement-raised gilts that are not ready to breed at the normal 8- to 8½-month age. Typically, about half are sexually immature, says SEA physiologist Ronald K. Christenson. The remainder are behaviorally anestrous—that is, they have normally developed reproductive tracts but are not exhibiting estrous behavior.

Research at the U.S. Meat Animal Research Center, (USMARC) indicates that genotype, season of the year, and type of confinement may influence development of these conditions. An initial study ruled out crowding and limited feeding as causes.

SEA physiologists Joe Ford and Howard S. Teague compared gilts raised in usual pen space and 50 percent of normal space per gilt—the latter so crowded that animals were forced to lie upon one another. Forty-three of 51 crowded gilts and 43 of 50 uncrowded gilts expressed estrus before they were 240 days old. Crowding reduced average daily gains and lowered feed-use efficiency but had no effect on feed intake or age at first estrus, the researchers found.

A second experiment ruled out limited feeding as a cause of delayed puberty. Average age at first estrus varied only 8 days in gilts grown on three dietary energy levels—control diet fed free choice, 90 percent of control energy intake, and control diet fed only 2 hours once daily. Fifty-one of the 52 gilts exhibited estrus by the time they were 240 days old.

But Drs. Christenson and Ford found a marked influence of genotype in studies with 428 purebred Hampshire, Duroc, Yorkshire, Swedish Landrace, and Large White gilts grown in total confinement. At 6 months of age, 69 percent of the Landrace gilts had regular estrous cycles as did 10 percent of the Hampshires but less than 5 percent of gilts of the other three breeds.

Genetic differences remained when the gilts were 8½ months old, normal breeding age. Eighty to 85 percent of the Landrace and Large White gilts were expressing regular estrous cycles but only 70 percent of the Hampshires and Durocs, and 56 percent of the Yorkshires were doing so. Examination of reproductive tracts of the noncyclic gilts slaughtered at 8½ months showed that 55 percent were sexually immature and 45 percent were behaviorally anestrous.

While experiments with behaviorally anestrous gilts show that the condition is reversible with the use of a drug, Dr. Christenson says drug therapy is not a practical solution to the problem. Studies are continuing at USMARC to obtain basic information on the physiology of puberty and to determine the influences of genotype, season of the year, and type of confinement housing. The ultimate objective is to obtain optimum sexual development of replacement gilts grown in total confinement.

Solution of the delayed puberty problem would help economically pressed producers avoid extra costs of maintaining gilts that cannot be bred at the normal time or that cannot be bred because they are behaviorally anestrous. The net result would be more pigs marketed per gilt raised.

Drs. Ronald K. Christenson and Joe Ford are at the U.S. Meat Animal Research Center, P.O. Box 166, Clay Center, NE 68933.—*W.W.M.*

New Treatment for Malignant Tumors in Animals

Above: *Veterinary technician Molly Madison (left) administers a general anesthesia to a horse afflicted with melanoma (in the eye) while Dr. Pamela Wagner (center) and Dr. Farrell remove the tumor for subsequent bioassay by a lab pathologist (0678X756–12).*

Cryotherapy, a quick, painless freezing technique may prove to be an effective treatment for malignant cancer in swine and other animals.

SEA veterinarian R. Keith Farrell, Pullman, Wash., has found that freezing malignant melanoma tumors on an animal arrests the development of both treated and untreated tumors on that animal within a few months. Why the untreated tumors are also affected by the freezing is unknown, but Dr. Farrell suspects the treatment may trigger some type of immunity response.

Malignant melanoma is perhaps the worst of all forms of cancer. It is notorious for spreading rapidly when tampered with by surgery, manipulation or diagnostic procedures. Once it is contracted, death seems inevitable.

Dr. Farrell has quite possibly changed this grim outlook. Using his cryotherapy technique—which entails applying a brass or copper rod that has been superchilled in liquid nitrogen directly to the tumor and holding it there for several seconds—Dr. Farrell has had positive results with a number of diseased horses, some of which were diagnosed as having no chance for survival.

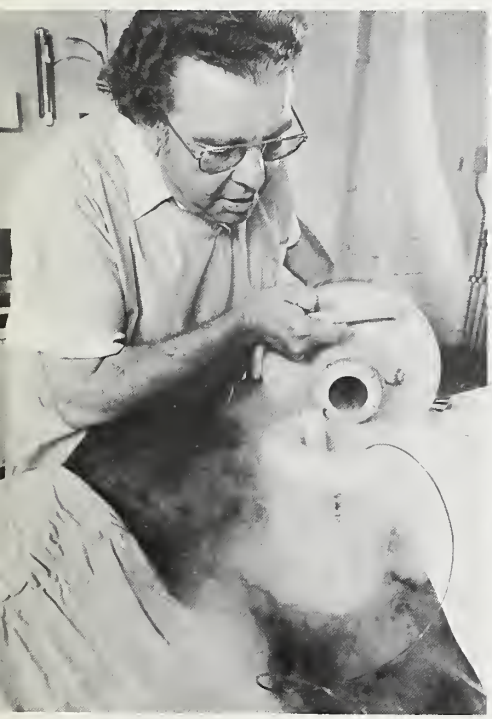
Dr. Farrell originally used his technique to produce unalterable identification marks on livestock (see AGR. RES., Feb. 1975, p. 9) and to de-scent skunks and billy goats. His success with cryotherapy for treating tumors and other pathologic lesions runs contrary to reports in human medicine that do not consider chilled metal rods effective.

A recent test that Dr. Farrell ran on swine—the best animal model for malignant melanoma—has added greatly to science's knowledge of the disease. Dr. Farrell successfully treated two pigs exhibiting malignant melanoma. One pig eventually reached market weight and was slaughtered, but the other was bred back to her original carrier sire who showed no malignant melanoma lesions. The resulting litter contained one malignant melanoma pig.

"This birth heralds the first time we have been able to produce pigs from a sow that has or once had lethal malignant melanoma," says Dr. Farrell, "and this is an absolute indicator of a genetic predisposition. Now, this doesn't mean that lethal malignant melanoma is a genetic disease—we don't know that—only that there is definitely a genetic predisposition."

Dr. Farrell is also quick to caution that it will be at least 5 years after treatment before his technique can be declared a cancer cure. In addition, at this point he doesn't know if the positive results are permanent or if the cryotherapy will have to be periodically readministered.

Dr. R. Keith Farrell is located at Room 202, Wegner Hall, Washington State University, Pullman, WA 99164.—*L.C.Y.*



***Above:** Cryoprobe tips are shaped to precisely fit the area being treated—in this case, the eyeball of a horse (0678X56–26). **Left:** Dr. Farrell pours liquid nitrogen into a "dewar" (an insulated bucket named for the inventor of the thermos) in which cryoprobes are chilled (0678X756–4).*

Right: After spraying along drainage ditches to kill weeds such as hoary crest, researchers will replace the weeds with a cover grass to lessen the green peach aphid's chances for survival (1077X1360–17).

Below: Dr. Tamaki displays sugarbeets infected with Beet western yellows virus transmitted by green peach aphids. The virus causes leaves to fade to a light yellow and, as the disease progresses, bleach to a tan. This "chlorosis" restricts photosynthesis and results in stunted sugarbeets (1077X1360–29).

Controlling Green Peach Aphids Witl

A TEAM of SEA researchers has found that control of the notorious green peach aphid without using insecticides seems possible if weeds growing on the peach orchard floors and in drainage ditch banks are replaced with a grass cover.

The green peach aphid is the number one pest of vegetable and sugarbeet crops in the world. Although the insects feed on these crops, their greatest damage is caused by the virus diseases they transmit—the worst of these being the potato leaf roll virus and the yellows viruses on sugarbeets. These diseases are responsible for hundreds of millions of dollars in losses each year.

Currently, pesticides—particularly the granular insecticide, TEMIK—are being used to control the aphids. However, the inadequacy of these chemical controls is evident by the high dollar damages still caused by aphids surviving such treatments. Furthermore, the aphids are rapidly building up resistance to current insecticides and no effective replacements are on the horizon.

The research team spearheaded by entomologist George Tamaki, Yakima, Wash., and also including entomologist Bill Butt and technician Lee Fox, also of Yakima, and plant physiologists Alex G. Ogg and Richard D. Comes, of Prosser, Wash., has been studying the life cycle of the green peach aphid. The team now believes that it has found a "weak link" in the aphid's life cycle that might be exploited to control the

ut Pesticides

pest without the use of pesticides.

The "weak link" is the aphid's dependency on virus-hosting weeds such as broad-leafed orchard weeds and hoary cress ditch bank weeds for survival. By replacing these weeds with grasses on which the aphids can't survive, the SEA team hopes to suppress the overall population of the aphids and also reduce the percentage of disease-carriers among the aphids that do live. This would increase the production of crops that are affected by the viruses which the aphids carry without polluting the environment.

Green peach aphid eggs overwinter on peach trees, then hatch in the spring. To build up their numbers, the first two generations are wingless and do not

Above: Colonies of green peach aphids are maintained for study at the Yakima Agricultural Research Laboratory (1077X1362–26A).

travel far from their place of birth. The third generation is winged in the adult stage and leaves the orchard and heads for weeds and cultivated crops. If an aphid finds a suitable plant it lives—if not—it dies.

The winged aphids that develop on peach trees will not carry disease because peach trees are not hosts to potato leaf roll virus or sugarbeet yellows viruses. But if these aphids develop on virus infested broad-leafed orchard weeds, they may become virus-carriers.

Many aphids and their eggs fall from peach trees into surrounding orchard weeds. Orchard growers, who generally trim 60 to 80 percent of the twigs in the winter, further aggravate the problem by allowing the twigs to fall and remain on the orchard floor. This is tantamount to seeding the orchard with aphid eggs—the SEA team estimates that as many as 200 million green peach aphids per acre (0.4 hectares) can be found in the weeds of cultivated orchard floors.

In its study, the SEA team has found no green peach aphids on cover crops such as orchard grass. It has also found that the aphids overwinter as nymphs and adults in drainage ditches and their chances for survival are highest near warm water springs, following mild winters. The team feels certain that selective control of hoary cress near warm springs, and replacing orchard and drainage weeds with grass, should adequately control aphid populations in all but the mildest of winters.

Dr. George Tamaki is at 3706 West Knob Hill Boulevard, Yakima, WA. 98902.—*L.C.Y.*

Above: *Research technician Lee Fox inspects hoary crest growing along drainage ditch for evidence of green peach aphids (1077X1360–6).*

Below: *Wingless, viruliferous green peach aphids transmit the Beet western yellows virus to sugarbeets by feeding on the beet leaves. The virus is injected through the beak of the aphid while the aphid sucks sap from a leaf phloem—that part of the vein carrying plant nutrients (1077X1364–6).*

Rope-wick Applicator for Weeds

Like rain in Biblical days, herbicides fall upon weeds and crops alike. The systemic herbicide glyphosate, while effective against such perennial weeds as johnsongrass and purple nutsedge, may occasionally damage crops. Recirculating sprayers can be used to apply nonselective herbicides to weeds taller than row crops, but a recently developed rope-wick herbicide applicator offers greater precision and selectivity in weed control. Glyphosate has not yet been registered for use with either type of applicator.

The rope-wick applicator was developed to apply nonselective systemic herbicides either above or below the canopy of row-crop plants. The loose-woven nylon wick conveys the herbicide to weeds that touch the wick as the tractor moves through the field. Herbicide on the wick is replenished by capillary movement of herbicide solution from a reservoir. Contact of the wick with crop plants is avoided by using specially designed supporting booms.

Tractor-mounted wick applicators using glyphosate were successful in controlling johnsongrass, sunflower and velvetleaf in soybeans under controlled conditions. In field tests, glyphosate applied above the soybean canopy by a rope-wick applicator controlled johnsongrass in soybeans as effectively as glyphosate applied by a recirculating sprayer. The rope-wick application resulted in a 51-percent increase in soybean yield as compared to an 18-percent increase in yield from plots treated with the recirculating sprayer. Greater precision in application of the herbicide could account for the greater yield when the herbicide was applied by the rope-wick applicator. In another field test purple nutsedge was controlled on noncropland by glyphosate. The chemical had been applied with a wick applicator which was designed for use below a crop canopy. According to J. E. Dale of the Southern Weed Science Laboratory, the rope-wick applicator could also be used very successfully throughout the growing season with nonselective herbicides. The herbicides are used against weeds that are taller in height than the crops.

Mr. Jim E. Dale is with the U.S. Delta States Agricultural Research Center, P.O. Box 225, Stoneville, MS 38776.—*E.L.*

Moth Controls Nutsedge Weeds

The larvae of an indigenous moth may one day control purple and yellow nutsedge weeds in crops.

Researchers established a laboratory colony from field-collected larvae of the moth, *Bactra verutana* Zeller. Laboratory studies revealed that the larvae preferred purple and yellow nutsedge to an artificially prepared laboratory diet. Detailed knowledge of the behavior patterns of the larvae was required before field releases would be effective.

Preliminary studies revealed that field releases should be initiated immediately after crop planting. While the crop is too small to shade the weeds, nutsedges grow rapidly. Massive saturated larval field releases are recommended because the cool temperatures of the mid-May to late June release period tend to slow larval development. Releasing an average of five larvae per shoot shortly after nutsedge shoots appear should result in all shoots being infested during a 3-week period.

The larvae are injurious after a single early-season release and are more mobile and less cannibalistic than previously suspected. According to researchers Dr. Kenneth E. Frick and Ms. Rebecca F. Wilson of the Southern Weed Science Laboratory, Stoneville, MS 38776, serial releases cause the greatest weed injury and offer the best promise of biological nutsedge control. Further successful field trials may be required before this becomes a widely utilized method of weed control.—*E.L.*

Among Alfalfa Weevils

Oh, East is East, and West is West,
and never the twain shall meet,
Till Earth and Sky stand presently
at God's great Judgement Seat;
But there is neither East nor West,
Border, nor Breed, nor Birth,
When two strong men stand face to face,
Though they come from the ends of the earth.—

RUDYARD KIPLING.

East Meets West in Nebraska

KIPLING obviously did not have in mind the eastern and western strains of the alfalfa weevil. They did meet, in east-central Nebraska about 5 years ago, as each continued to spread from their points of accidental introduction into the United States.

But Kipling was right that East and West maintain their identities—even in alfalfa weevils. "Neither population appears to offer any serious constraint on movement of the other," says SEA entomologist George R. Manglitz, Lincoln, Nebr. "The intermixing of strains went unnoticed except by entomologists," he says.

Dr. Manglitz says the western strain continues its predicted spread eastward, about 10 miles a year, as it has since it was found in Utah in 1904. And the eastern strain discovered in Maryland in 1951 still moves west about 50 miles (80 kilometers) a year.

The faster-moving eastern population also built up generally damaging numbers more rapidly in Nebraska. The eastern strain reached damaging levels by the fourth season after it reached Otoe County, on the Nebraska-Iowa border. Not until the tenth season after arrival did the western strain become generally damaging in Dawson County, in central Nebraska.

Both strains now coexist in a band about 150 miles (240 kilometers) wide in Nebraska, probably also in Kansas and Oklahoma, and possibly in South Dakota and Texas, the entomologist says. The western strain probably came from Central Europe as indicated by the research of SEA entomologist R. F. W. Schroder, Beltsville, Md. The source of the eastern strain is unknown. Subtle differences in anatomical proportions can be detected by entomologists only when a series of specimens is compared.

Partial reproductive incompatibility of the strains was first demonstrated by SEA entomologist Carl C. Blickenstaff, Kimberly, Idaho. An eastern female mated to a western male lays eggs, but none or at most 1 percent hatch. The cross of a western female and an eastern male is fertile but produces an abnormal ratio of male and female offspring—up to 70 percent female.

The eastern weevils have been credited with greater ability to encapsulate eggs of the parasitic wasp *Bathyplectes curculionis* (as first reported by SEA entomologist Benjamin Puttler, Columbia, Mo.), and thus avoid destruction by this introduced natural enemy. In the sixth season after each strain arrived in Nebraska, however, parasitism reached 85 percent in eastern weevils and only 55 percent in western weevils. Somehow, under field conditions, the parasite could overcome the eastern weevil's defenses.

Dr. Manglitz has sampled alfalfa weevil populations for 11 years in Dawson County, where the western strain arrived in 1965, and for 6 years in Otoe County, where the eastern strain invaded in 1970. In 1974, his projections of weevil spread suggested a general intermixing of the two strains somewhere in the 160 miles (256 kilometers) separating the two counties.

Perhaps the demonstrated sterility of the western female-eastern male cross could be used to determine where the two strains had joined forces. Former University of Nebraska graduate student Lyle E. Klostermeyer and Dr. Manglitz sampled weevils in an east-west band eight counties wide in south-central Nebraska, then crossed the collected males with eastern females from a laboratory colony which originated with weevils obtained from Maryland.

In 1975, all crosses with females from Otoe and three adjacent eastern counties were fertile. Apparently, only the eastern strain was present there. Production of both viable and nonviable eggs in crosses from central counties indicated both types of females had been collected, and the strains were intermixed. On the western end of the eight counties, only the western strain was in Dawson County; all crosses were sterile as would be expected if western males from the field were mated with eastern laboratory females.

Similar test crosses in 1976 indicated arrival of eastern weevils in Dawson County as well as the advance of western weevils into another county. By 1977, the eastern strain had not yet spread beyond Dawson County to Lincoln County to the west.

Dr. Klostermeyer and Dr. Manglitz suggest that a micro-organism may cause the reproductive incompatibility between the alfalfa weevil strains. In mosquitoes, a similar incompatibility is produced by a rickettsia-like micro-organism, which can be controlled with antibiotics.

Feeding alfalfa foliage dipped in tetracycline solution to alfalfa weevils before cross-breeding restored fertility or eliminated abnormal sex ratios of offspring in some test crosses. Similar treatment with penicillin had no effect. Dr. Manglitz says further studies are needed to verify these results.

Dr. George R. Manglitz is with the Forage Insect Laboratory, University of Nebraska, East Campus, Lincoln, NE 68583.—*W.W.M.*

Progress in the Fight Against Screwworms

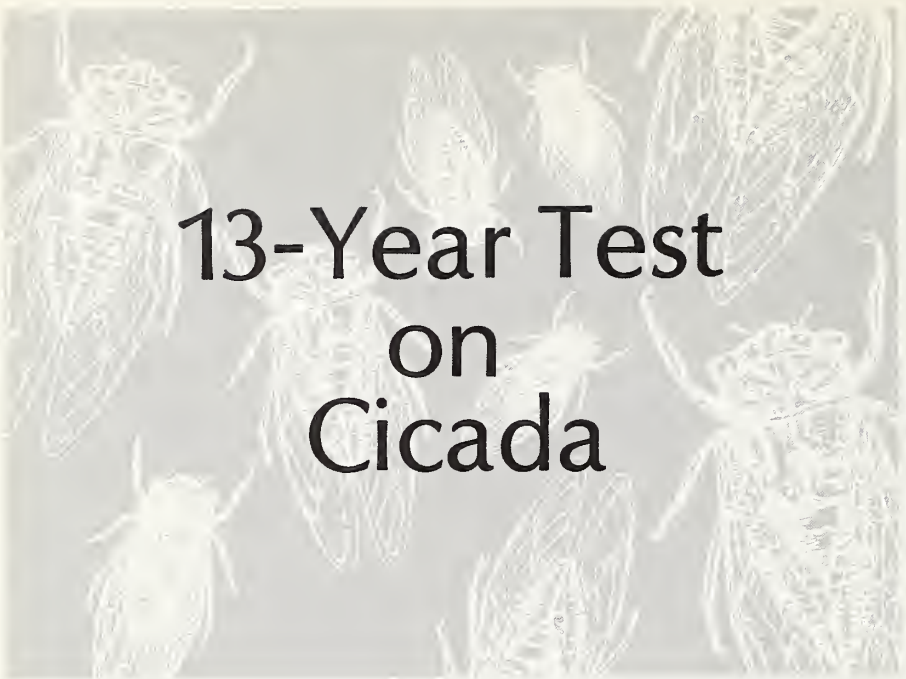
NINETEEN seventy-seven was the best year in the history of the 16-year-old sterile fly biocontrol program to control the screwworm fly, a major pest of livestock and other animals.

The fly is about twice the size of the common housefly, has orange eyes, a blue-green body, and is rarely seen except around animal wounds. The female fly lays its eggs in an open wound; in a few hours, the eggs hatch into larvae which begin to penetrate the wound. In 5 or 6 days, the larvae grow from microscopic size to as large as 1.3 centimeters in length (.52 inches). The open wound attracts more screwworm flies, which lay more eggs, and soon the animal is beyond help. In this way, screwworm flies cause millions of dollars of losses each year by attacking livestock throughout Mexico and then seasonally invading the Southwestern United States.

The total number of confirmed cases of screwworms, *Cochliomyia hominivorax* (Coquerel), reported in the United States during 1977 was only 457 compared with 29,671 for the previous year. Texas, normally the most heavily infested State, was free of screwworms for the longest time in any summer on record and had a total of only 39 cases. Although the unusually cold winter in Texas during 1976 and 1977 and a dry spring may have helped reduce the overwintering population, near-normal incidents of screwworm activity were reported in the other Western States. The screwworm program has the goal of eliminating this pest from the southwestern United States and most of Mexico.

The great improvement in screwworm control resulted primarily from: an improved dispersal system; use of an improved strain of flies; and the increased ability of sterile flies from a new factory in Tuxtla Gutiérrez, Mexico. Substitution of rented aircraft for USDA aircraft in Texas freed USDA aircraft for use in Mexico and enabled releases to be made farther south into Mexico to prevent northward movement of screwworm flies into the United States.

A new strain of flies, designated 009, was developed and placed in mass production. The new strain was developed from 50 egg masses collected from eight south Texas counties and systematically combined to insure genetic representation from each location. Production of the sterile flies at the new factory in Tuxtla Gutiérrez, doubled the number of sterile flies available for release. Continued progress and the establishment of a new barrier in the Tuxtla Gutiérrez area across the Isthmus of Tehuantepec may foretell the demise of the screwworm as an economic threat to U.S. livestock and other animals, according to Dr. J. Wendell Snow and Dr. Chandler J. Whitten of the Screwworm Research Laboratory, P.O. Box 986, Mission, TX 78572.—*E.L.*



13-Year Test on Cicada

Scientists, like the 13-year cicada, need a lot of patience. In 1963 entomologist Donald W. Hamilton, a USDA researcher, tried six insecticides on cicada and then waited 13 years to see how effectively they controlled this pest.

There are two types of periodic cicada in the United States. One requires 13 years for full development, the other takes 17 years. Different broods emerge at different times and places, so emergence of one or more broods occurs every year somewhere in their range. Cicada emerge in enormous numbers over a 2- or 3-week period in late spring or early summer and move into trees and other woody vegetation.

The female makes deep slits in the twigs of trees and shrubs where she places her eggs. The twigs and small branches are damaged and often killed by the egg laying activity. This can be a serious problem in apple and peach orchards, and to ornamental plants.

The eggs hatch and the young nymphs drop to the ground and burrow down and attach to plant roots. There they stay, feeding and growing for 13 or 17 years.

Control of the adult cicada is difficult because it does not feed after emergence. So, several applications of a contact insecticide are required within a 2- or 3-week period because large numbers of adults emerge each day.

Mr. Hamilton was working at what is now the USDA's Fruit and Vegetable Insects Research Station, Vincennes, Ind., in 1963 on control of apple pests when an outbreak of the periodical cicada occurred in the area.

Mr. Hamilton counted as many as 63 nymphs per square foot (0.09 square meters) in the apple orchards, which meant about 43,000 nymphs were feeding on the roots of each apple tree.

He suspected that severe decline in the health of apple trees, often blamed on various causes, was actually caused by the cicada's long and heavy feeding on the tree roots in preparation for their coming out party.

Mr. Hamilton and a coworker, entomologist Merrill L. Cleveland, developed an experiment to test the effect of several pesticides on the cicada. They applied six pesticides to a heavily infested apple orchard in July 1963. They also tested two application methods, a foliar spray and a ground treatment, for each chemical.

They took counts of egg mortality later in the season and found some of the test materials produced a reduction in the egg hatch.

Then there was nothing more they could do for 13 years except hope that they or other researchers would be there to evaluate the results when the surviving nymphs emerged as adults in 1976.

Mr. Hamilton retired in 1968, and Dr. Cleveland transferred to USDA's National Agricultural Research Center, Beltsville, Md. However, Mr. Hamilton decided to retire in Vincennes, where he could keep an eye out for the next appearance of the cicada.

He was on hand in 1976 to remind the present research staff at the Vincennes Center, entomologists David K. Reed and Gary L. Reed, that the time had come to check on the cicada.

To evaluate the results of the pesticide applications the researchers placed screen cages over the roots of the treated and untreated apple trees and counted the emerging cicada from May 20 through June 15.

All the chemical treatments gave some degree of control but Phorate, Aldicarb, and Mexacarbate were more effective than Carbaryl, Demeton, and Dimethoate. At this time, of the chemicals tested, only carbaryl is registered by the Environmental Protection Agency and recommended by USDA for use against cicada in apples.

Cicadas emerging from the untreated areas ranged from 225 to 316 per cage. Plots treated with a foliar application of Mexacarbate 13 years before, averaged only 52 cicada per cage, a reduction of about 80 percent. The ground treatment with Phorate averaged 68 cicada per cage, and the foliar application of Aldicarb average 71, a reduction of about 75 percent.

"It was a long wait," Mr. Hamilton said "but I'm glad we did it. We know something now about which materials will reduce cicada damage."

This research was conducted at the Fruit and Vegetable Insects Research Station, P.O. Box 944, Vincennes, IN 47591.—*R.G.P.*

Citrus Rootstock: Good, Better and Best

WHETHER it's orange or grapefruit, certain citrus rootstocks are preferable to others in alleviating mineral deficiencies and toxicities in the tree. Analyses of the leaves of trees show that rootstocks have a strong effect on mineral nutrition.

These analyses can better aid breeders to develop hardy, productive stocks for a nearly $1½ billion citrus industry.

In tests in Texas, orange, grapefruit, and tangelo trees on *Severinia* rootstock had manganese concentrations in the leaves up to four times higher than those on sour orange, the standard commercial rootstock there. These trees also had high levels of phosphorus, potassium, zinc, and copper.

"Far more important than avoiding nutritional deficiencies is the ability of some citrus rootstocks to prevent toxicities, primarily chlorine and boron," says SEA horticulturist Heinz K. Wutscher.

"Generally, productivity and disease resistance are more important factors in choosing a rootstock than mineral uptake characteristics. But in areas with saline soil and irrigation water, rootstocks which keep down the chlorine and boron uptake are the only practical defense against toxicities," said Dr. Wutscher.

Part of an established, continuing study of citrus rootstocks, leaf analysis of rootstock tests in Florida showed that trees on trifoliate orange, trifoliate orange hybrids, Cuban shaddock, grapefruit, and rough lemon rootstocks accumulate more boron than trees on other rootstocks.

Cleopatra mandarin, Rangpur lime and, to a moderate degree, sour orange are chlorine tolerant. Macrophylla is the most boron tolerant of the commonly used citrus rootstocks; trees on Macrophylla also tolerate herbicides better than do trees on other rootstocks.

Soil conditions influence nutritional effects of rootstocks; trees on Cleopatra mandarin are highly chlorosis tolerant on sandy soil but are chlorosis-prone on clay soils.

The type of irrigation used may also modify mineral uptake of rootstocks. In a test comparing flood, drip, and subirrigation with water containing high levels of chlorine and boron, young grapefruit trees on 15 rootstocks responded to the way the solutions were applied. Trees on 10 of the 15 rootstocks tested took up less chlorine in sandculture with subirrigation than with drip or flood irrigation in the field. Trees on 14 of the 15 rootstocks took up the same amount of chlorine with flood and drip irrigation. The same was true for boron uptake, except for trees on Macrophylla, which accumulated relatively large amounts of boron with drip irrigation.

Citrus blight, currently the most serious tree decline problem in Florida (AGR. RES., May 1978, p. 8) affects trees on rough lemon and some other rootstocks far more severely than it affects trees on sour orange and Cleopatra mandarin.

One possible cause of tree decline may lie in how the rootstocks take up those all-important minerals, says Dr. Wutscher.

Dr. Heinz K. Wutscher is with the U.S. Horticultural Field Station, 2120 Camden Road, Orlando, FL 32803.—*P.L.G.*

Automatic Sprayer for Safety

HANDLING and applying pesticides creates a risk for spray equipment operators. SEA researchers at USDA's Agricultural Engineering Research Unit, Wooster, Ohio, are developing an experimental sprayer designed to avoid most of these handling risks.

"On our sprayer all liquid flows are controlled from the control panel by the operator," agricultural engineer Donald L. Reichard says. "Metering pumps draw the chemicals from their containers, at rates proportional to travel speed, and mix them with water in a small mixing chamber on the way to the sprayer nozzles."

This system eliminates the dangerous pesticide pouring operation as well as the disposal of left-over tank mixtures. Also, the operator can flush the containers from the control panel, Mr. Reichard says.

Mr. Reichard and technicians D. L. Collins and P. T. Keck are developing the sprayer as part of their overall effort to improve the efficiency and safety of chemical pesticide application equipment.

Mr. Donald L. Reichard is at Room 204, Agricultural Engineering Building, Ohio Agricultural Research and Development Center, Wooster, OH 44691.—*R.G.P.*

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Shocking Weeds

WEEDS MAY be in for a shock if research on the use of an electrical discharge to control weeds proves successful. Researchers studied the effects of electrical shocks on weeds and crops in order to determine the level of energy (joules) required for weed control without harming crops.

Greenhouse and field studies were conducted using 1,500 to 3,000 volt charges. In greenhouse studies at 3 weeks after emergence, cocklebur was the most susceptible and hemp sesbania was the least susceptible to damage from electrical discharges. In field tests at 3 weeks after emergence, cocklebur was the most susceptible and velvetleaf, the least susceptible to damage. At 4 weeks after emergence, prickly sida was the most susceptible and velvetleaf was affected the least. Although responses varied considerably with species and plant age, greenhouse plants were more sensitive and field plants were more tolerant at all energy levels. The energy required for a lethal response on field plants was approximately ten times greater than that required for plants confined to pots in the greenhouse.

In field tests with crops, electrical discharge applicators were mounted on a two-row cultivator in two different positions so that the crops and weeds within the crop rows were both treated. Cotton plants were treated 6 to 7 weeks after emergence and soybeans after either 4 or 5 weeks. In tests on cotton and soybeans where the wire applicators overlapped the crop row by 5 cm, yield reductions occurred at 3,000 volts. If the wire applicators were set to barely touch the edge of the crop row, no yield reductions occurred at voltages up to 3,000 in cotton and 2,500 in soybeans.

The research was conducted by Dr. James M. Chandler of the Southern Weed Science Laboratory, P.O. Box 225, Stoneville, MS 38776, in cooperation with LASCO Inc., of Vicksburg, MS—*E.L.*

Leukemia Inhibiors Synthesized

THE SAME group of chemists who discovered harringtonine, a leukemia inhibitor, in a rare Asian evergreen tree called a Japanese plumyew, now have synthesized it from a more abundant plumyew component that is not active against leukemia.

Kenneth L. Mikolajczak and Cecil R. Smith, Jr., chemists in the Northern Regional Research Center, Peoria, Ill., synthesized harringtonine from cephalotaxine, another compound from the plumyew. Since cephalotaxine can be made from commercially available starting materials, the Northern Center research outlines final steps for commercial production of harringtonine.

Harringtonine and some other chemical compounds extracted from the rare plumyew evergreen slowed the progress of leukemia in laboratory mice in U.S. tests when the compounds were discovered in 1969. The leukemia-inhibiting chemicals also showed promising results in human clinical tests reported in the People's Republic of China in 1976.

Mr. Mikolajczak said he and Dr. Smith used an "indirect sequence" of reactions to make harringtonine from cephalotaxine. Although cephalotaxine is the chemical parent of harringtonine in the tree, *Cephalotaxus harringtonia,* direct synthesis in the laboratory was "thwarted" by the complex three-dimensional structure of cephalotaxine, Mikolajczak said.

Dr. Smith's group has studied chemical synthesis of the active esters of cephalotaxine, including harringtonine, since Richard G. Powell, one of the group, discovered the inhibitors in 1969.

Trees in the *Cephalotaxus* genus, native to eastern Asia, are rare in the United States, grow slowly and yield only small amounts of the leukemia inhibitors. In one extraction, for example, Mr. Powell and Dr. Smith obtained 36 grams (about 1.3 ounces) of active inhibitors from 25 trees weighing 455 kilograms (about 1,000 pounds).

Another group at the Northern Center is studying plumyew tissue culturing as a possible lead to the fermentative production of the leukemia inhibitors (AGR. RES., Aug. 1977, p. 3).

The address of the Northern Regional Research Center is 1815 N. University, Peoria, IL 61604.—*D.H.M.*

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